Space Research
at Los Alamos National Laboratory

Illinois Physics Virtual Careers Seminar

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Scientist, ISR-2
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Outline

1. Very short history of Los Alamos National Laboratory (2 slides)
2. Very short overview of what LANL does today (3 slides)
3. Space research at LANL
4. Why LANL is a great place to be a postdoc* 
5. Why Los Alamos is a great place to live*

* My opinions
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The Manhattan Project

- 1938: Nuclear fission discovered
- 1939: WWII begins in Europe
- 1939: Einstein-Szilard letter to FDR
- 1942: Manhattan Project begins
- 1943: Work begins at Los Alamos, NM
- 1945: World’s first nuclear test
- 1945: Nuclear weapons used on Hiroshima and Nagasaki
After World War II

- Nuclear testing and research continue at Los Alamos and elsewhere
- Around 1947: Cold War begins
- Stockpiling of nuclear weapons
- 1952: First thermonuclear test
- 1958: Testing moratorium
- 1963: Limited Test Ban Treaty
- 1992: Last US nuclear test
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LANL today

Aerial view of Los Alamos and LANL

LANL land area compared to Washington, DC

46 square miles
2,436 buildings
LANL budget

Total: $3.4 billion

- DOE Office of Science: $114M / 4%
- DOE Energy & Other Programs: $80M / 2%
- DOE Environmental Management: $33M / 1%
- NNSA Safeguards & Security: $146M / 4%
- NNSA Nonproliferation: $325M / 10%
- Strategic Partnerships: $307M / 9%
- NNSA Weapons Programs: $2,381M / 70%

Photos: LANL Flickr

Plutonium manufacturing
Stockpile stewardship

https://www.lanl.gov/about/facts-figures/budget.php
Global Security at LANL

• Provide scientific and technical expertise for the U.S. government
• Nuclear nonproliferation
• Nuclear counterproliferation
• Counterterrorism
• Emerging threats including cyber and space
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Detecting nuclear explosions

- Did it happen?
- Was it nuclear?
- Where was it?
- How big was it?

**Low Altitude**
- Optical
- Electromagnetic Pulse
- Infrasound

**Transition Region**
- Optical
- Gamma Rays
- Neutrons

**Space**
- Gamma Rays
- Neutrons
- X-rays

**Below Ground**
- Seismic
- Hydro-acoustic

**Low Altitude**
- Optical
- Electromagnetic Pulse
- Infrasound
Detecting nuclear explosions

Transport Media
- Vacuum
- Air
- Oceans
- Earth

Detectors
- Neutrons
- Gamma-Ray
- Charged Particle
- X-ray
- RF
- Optical
- Infra-sound
- Radio-nuclide
- Hydro-acoustic
- Seismic

Nuclear Detonation n, γ, FF, ν

- Gamma-ray bursts
- Space Environment
- RF signals
- Lightning
- Sun Glint
- Earth Albedo
- Lasers
- Bolides
- Radiation Sources
- Conventional Explosions
- Earthquakes
- Volcanoes
NASA space science missions
Perseverance rover landing on Mars – February 18, 2021
SuperCam
Laser Remote Sensing + Imaging, IR Spectra & Sound

Nd:YAG
12 mJ

Laser plasma → atomic emission (LIBS)

Time-Resolved Remote Green Raman Spectroscopy
SuperCam Mast Unit

- Telescope
- Electronics Box
- Laser
- Handling Fixture
- Periscope
- Insulating Feet
- Heater
Design to delivery
All-woman team commands rock-zapping laser on Mars

The team is responsible for sending commands to the ChemCam instrument, which shoots Martian rocks with a laser to determine their chemical make-up.
ISR-1 & ISR-2
Physicists
Nuclear engineers
Planetary scientists
Etc

ISR-3
Computer scientists
Software engineers
Data scientists

ISR-4
Electrical engineers
Computer engineers

ISR-5
Mechanical engineers
Systems engineers
Technicians
Project controls
Thinking Telescopes

• Problem: current telescope systems make 1 billion observations per night

• Solution: autonomous robotic systems that “think” and respond to data in real time

• Automatic detection and follow-up for astrophysical transients like gamma ray bursts
Thinking Telescopes

Full-sky persistence

Interesting event cues

Full-sky scan
Thinking Telescopes

Interesting event cues

Follow up with bigger, NFOV telescopes
ELROI satellite license plate

19,000+ space objects are tracked today.

CubeSats are being launched 100+ at a time. Which one is yours?

Satellites need a “license plate” that anyone can read from the ground.
ELROI satellite license plate

Photon-counting sensor

Spectral filter

Photon timestamp data

$t_1, t_2, \ldots, t_n \rightarrow ID$

Telescope

Blinking light with milliwatt average power encodes ID number
ELROI satellite license plate

Current size

Final size
NCam single-photon camera

- Images built up one photon at a time
- Single-photon sensitivity with high time resolution (<1 ns) and very low noise
- Large format imaging
Aurora research with NCam

Aurora is dim and hard to study without long exposures

Observe with NCam – find new faster behavior?
Aurora research with NCam

Aurora oscillations can be linked to Earth’s magnetic field.
Aurora research with NCam

Rocket launch and aurora at Poker Flat Research Range
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LANL is a great place to be a postdoc

• Exciting research
• World-class mentors and colleagues
• Learn new things, lots of variety
• Opportunity to get a security clearance and do classified work
• Path to a permanent position if you like it here
• Treated as a valued colleague and team member
• ISR Early Career Group organizes social activities and professional development
LANL is a great place to be a postdoc

- Better pay compared to universities
- Great benefits - same as LANL staff
- Work/life balance
- Flexible work schedules (alternate Fridays off, 4/10s, etc)
- Dual-career support
Total Employees
12,304

75.6% Regular/Term
4.6% Graduate
9.5% Craft
6.1% Undergraduate
4% Postdoc

Female
32.4%

Male
67.6%

1.8% American Indian, Alaskan Native, Native Hawaiian, or Other Pacific Islander
5.3% Asian
1.4% Black or African American
37.8% Hispanic or Latino
1.4% Two or more races
52.1% White
<table>
<thead>
<tr>
<th>Types of jobs</th>
<th>% Women</th>
<th>% URM</th>
<th>% OPC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Senior Leadership</strong></td>
<td>28.57%</td>
<td>10.20%</td>
<td>0.00%</td>
</tr>
<tr>
<td>Director/President, Deputy Director/Vice President, Associate Lab Director</td>
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<tr>
<td><strong>Research/Technical Management</strong></td>
<td>23.71%</td>
<td>12.37%</td>
<td>5.84%</td>
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<tr>
<td>(First-line and Mid-level) Engineering Management, Research Management, Technical Management</td>
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<td></td>
</tr>
<tr>
<td><strong>Operations (or Research Support) Management</strong></td>
<td>29.68%</td>
<td>39.70%</td>
<td>1.11%</td>
</tr>
<tr>
<td>Business Management, Computer Systems, Communications, ESHQ, Facilities Ops, HR, Legal, Tech Transfer, Strategic Planning</td>
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<tr>
<td><strong>Technical Research Staff</strong></td>
<td>23.33%</td>
<td>15.62%</td>
<td>7.90%</td>
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<tr>
<td>Non-management: Researchers, Scientists, or Engineers</td>
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<tr>
<td><strong>Operations Support Staff</strong></td>
<td>42.29%</td>
<td>52.76%</td>
<td>1.95%</td>
</tr>
<tr>
<td>Non-management: Support Roles</td>
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<tr>
<td><strong>Post Doctoral</strong></td>
<td>24.85%</td>
<td>6.78%</td>
<td>36.76%</td>
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<tr>
<td>(Post-doc employees)</td>
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<tr>
<td><strong>Graduate Students</strong></td>
<td>37.34%</td>
<td>24.40%</td>
<td>14.79%</td>
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<tr>
<td>(Funded by Lab)</td>
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<tr>
<td><strong>Undergraduate Students</strong></td>
<td>44.92%</td>
<td>43.58%</td>
<td>6.68%</td>
</tr>
<tr>
<td>(Funded by Lab, do not include undergrad student funded by DOE directly (i.e. SULI))</td>
<td></td>
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</tbody>
</table>
What you may not like

- Rules
- More rules
What is LANL like during the pandemic?

• “Normal operations with maximized telework”
• Translation: work at home as much as you can, come on site when you need to
• Vaccinations are happening
New Mexico is #2 in vaccination rates

New York Times
2/22/2021
Industry  National Labs  Academia

More applied  "Science in the national interest"  More basic science
Profit-driven  

Exploration-driven  Publication-driven

Los Alamos National Laboratory
How I found a postdoc position

Google

los alamos space

Google Search  I'm Feeling Lucky
Postdoc program and hiring process

- Postdoc appointments are 2 years with option to extend to 3 years
- Fellowships are available
- You are eligible if you earned your PhD within the last 5 years
Postdoc program and hiring process

• Search for postdoc jobs at jobs.lanl.gov
• Network through collaborators, conferences, etc
• Send your CV to people who might be interested (we pass these around!)
• Read application instructions carefully
What I look for in a postdoc

• Useful skills AND potential to learn new things
• Demonstrated scientific excellence (conferences, publications, recommendation letters)
• Maturity, professionalism, ability to work on a team, self-directed
• Interest in LANL mission or excitement about LANL
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New Mexico

- About 2,000,000 residents
- Most PhDs per capita (as of a 2000 study)
- Also ~20% poverty
New Mexico
Life in Los Alamos
Life in Los Alamos

- Small town living (~17,000 people)
- 7,355 feet above sea level
- Mild four-season climate: hot summers, cold winters
- Surrounded by National Forest, National Park, Pueblo, and other Federal lands
- Excellent public schools
- No restaurants open after 8 PM (okay probably a few)
- One brewery
- 90 miles from Albuquerque, 35 miles from Santa Fe, 55 miles from Taos
- Housing market is challenging
Other commuting options: 35-55 minutes

Santa Fe and Jemez mountains and other nearby communities
Other commuting options

Employee Spotlight: Jocelyn Buckley

November 27, 2018
Life in Los Alamos
Life in Los Alamos
America’s Healthiest Community: Los Alamos County

Home to a once-secret site for scientific research, the New Mexico county is No. 1 in U.S. News’ third annual Healthiest Communities rankings.

By Gaby Galvin, Staff Writer    Sept. 22, 2020
Outdoor recreation

• Hiking
• Camping
• Rock climbing
• Mountain biking
• Hunting and fishing
• Rafting
• Skiing/snowboarding
Outdoor recreation: skiing
Contact me: rmholmes@lanl.gov